

A Revision of *Bothriochloa* Kuntze (Poaceae) in Thailand

O. NEAMSUUVAN¹, J.F. VELDKAMP² AND T. SEELANAN^{1,3}

¹Department of Botany, Faculty of Science, Chulalongkorn University,
Bangkok 10330, Thailand.

²National Herbarium of The Netherlands, Leiden University,
P.O. Box 9514, 2300 RA Leiden, The Netherlands.
³E-mail: tosak.s@chula.ac.th

Abstract

Bothriochloa Kuntze (Poaceae) has 3 species in Thailand: *B. bladhii*, *B. ischaemum*, and *B. pertusa*. A key, descriptions, and illustrations are provided.

Introduction

The genus *Bothriochloa* was established by Kuntze in 1891. Its name is derived from the Greek words βοθρίον (bothrion, a small pit) and χλοη (chloë, young shoot, grass), which refers to the pitted lower glumes of the spikelets in some species of this genus (Bor, 1968). It belongs to the family Poaceae, tribe Andropogoneae, subtribe Sorghinae and comprises about 33 pan(sub)tropical species (Clayton, Harman and Williamson, 2008).

The genus is characterised by a translucent median channel in the joints and pedicels of the raceme. Its nearest relatives appear to be *Capillipedium* Stapf and *Dichanthium* Willemet, and because *B. bladhii* (Retz.) S. T. Blake can hybridise with some species of these two genera. Some have therefore advocated to unite the three into *Dichanthium*, the oldest name (De Wet & Harlan, 1966), but then infrageneric taxa are recognised, e.g., by Roberty (1960), who enumerated these three amongst no less than 12 sections in *Dichanthium*: *Dichanthium* sect. *Amphilophis* (Trin.) Roberty, *Dichanthium* sect. *Bothriochloa* (Kuntze) Roberty, and *Dichanthium* sect. *Dichanthium*.

Bothriochloa can be distinguished from the other two genera as follows:

- Inflorescence composed of subdigitate racemes, rarely paniculate, racemes with more than 8 spikelet pairs. *Bothriochloa*
- Inflorescence a panicle, racemes with 1-5(-8) spikelet pairs *Capillipedium*

- Joints of the rachis and pedicels with translucent longitudinal channels; all spikelet pairs heterogamous *Bothriochloa*
- Joints of the rachis and pedicels without translucent longitudinal channels; spikelet pairs heterogamous, excepting homogamous at basal spikelet pairs *Dichanthium*

For Thailand, Bor (1965) reported *B. glabra* (Roxb.) A. Camus and *B. pertusa* (L.) A. Camus without giving a key or descriptions. Sathagul (1990) in her Master's thesis recorded 6 species: *B. caucasica* (Trin.) C.E. Hubb., *B. glabra*, *B. insculpta* (Hochst. ex A. Rich.) A. Camus, *B. intermedia* (R. Br.) A. Camus, *B. ischaemum* (L.) Keng, and *B. pertusa* and provided a key and descriptions. Nanakorn and Norsangsri (2001) reported 5 species: *B. caucasica*, *B. glabra*, *B. intermedia*, *B. ischaemum*, and *B. pertusa*. However, because this was a mere checklist for Thai grasses there was neither a key nor a description. Later studies have shown that *B. caucasica*, *B. glabra*, and *B. intermedia* are to be considered part of the very polymorphic ("compilospecies": De Wet & Harlan, 1966) *B. bladhii* (Retz.) S.T. Blake.

In the present study in the framework of the Flora of Thailand Project, three species could be distinguished: *B. bladhii*, *B. ischaemum*, and *B. pertusa*. A key, descriptions, and illustrations are presented.

Materials and methods

This study was based on an intensive search through available taxonomic literature and a study of specimens kept at the herbaria in Thailand: the Bangkok Herbarium (BK), the Forest Herbarium, National Park, Wildlife and Plant Conservation (BKF), the Kasin Suvatabhandhu Herbarium, Department of Botany, Chulalongkorn University (BCU), The Herbarium, Department of Biology, Chiang Mai University (CMU), Prince of Songkhla University Herbarium (PSU) and The Herbarium of Department of Botany, Kasetsart University. Several herbaria abroad also were visited: the National History Museum, London (BM), the Royal Botanic Gardens, Kew (K), the Museum National d'Histoire Naturelle, Paris, France (P), the National Herbarium of The Netherlands, Leiden, The Netherlands (L), the Botanical Museum, Natural History Museum of Denmark, University of Copenhagen (C), and the Herbarium, Institute of Biological Sciences, University of Aarhus (AAU). Field work was carried out throughout Thailand during which additional ecological data and localities were recorded.

Bothriochloa Kuntze

Revis. Gen. Pl. 2: 762. 1891. -[*Bothriochloa* sect. *Eubotriochloa* Ohwi, Acta Phytotax. Geobot. 11: 166. 1942, nom. inval.]. -*Dichanthium* Willemet sect.

Bothriochloa Roberty, Boissiera 9: 159. 1960. – **Type species:** *Bothriochloa anamitica* Kuntze [= *Bothriochloa bladhii* (Retz.) S.T. Blake].

Andropogon L. sect. *Amphilophis* Trin., Mém. Acad. Imp. Sci. St. Pétersbourg, VI. Sci. Math. 2: 285. (1832) (rank indicated on p. 279). -*Andropogon* L. subgen. *Amphilophis* Trin. ex Hack. in Mart., Fl. Bras. 2(3): 291. 1883. -*Amphilophis* Nash in Britton, Man. Fl. N. States: 71. 1901. -*Bothriochloa* sect. *Amphilophis* Ohwi, Acta Phytotax. Geobot. 11: 166. 1942. -*Dichanthium* Willemet sect. *Amphilophis* Roberty, Boissiera 9: 167. 1960. – **Lectotype species** (not resolved). Not *Amphilophis torreyanus* Nash [= *Bothriochloa laguroides* (DC.) Herter var. *torreyana* (Steud.) M. Marchi & Longhi-Wagner, Bol. Inst. Bioci. Univ. Fed. Rio Grande do Sul 57: 52. 1998, f. 6, 19]. fide ING (<http://ravenel.si.edu/botany/ing/ingForm.cfm>), see note.

Tufted perennials. Culms slender. Leaf sheath keeled, glabrous; **ligules** membranous; leaf-blade flat. **Inflorescence** subdigitate or paniculate, composed of many racemes, each consisting of several pairs of sessile and pedicelled spikelets; joints and pedicels with a translucent longitudinal groove, flattened, hairy on both margins. Sessile **spikelets** dorsally compressed, elliptic, oblong to lanceolate, 2-flowered, callus short, shortly bearded; lower **glumes** as long as spikelet, smooth or pitted, 7-11-nerved, chartaceous to membranous, pubescent below the middle, laterally 2-keeled, pectinately setose on keel near tip, apex acute, margin inflexed; upper glumes equally long or somewhat shorter, boat-shaped, 3-nerved, 3-keeled, subchartaceous to hyaline, apex acute, margin inflexed; lower lemmas nerveless, hyaline; upper **lemmas** linear, hyaline, continuous with the geniculate and twisted awn; lower **paleas** absent; upper paleas small or absent. Pedicelled spikelet 1- or 2-flowered, the lower male or neuter, the upper neuter or more often suppressed; lower glume chartaceous, glabrous, margin inflexed; upper glume hyaline, glabrous, apex acute, margin inflexed; lower lemmas hyaline, glabrous; awnless.

Distribution: 33 species, throughout the (sub)tropics, 3 in Thailand.

Note: We have not seen Nash (1901), but this lectotypification seems incorrect. *Amphilophis torreyanus* was based on *Andropogon torreyanus* Steud. [(1840), *nom. nov.* pro *Andropogon glaucus* Torr. (1824), non Retz. (1789)]. This species is not to be found in Trinius (1832), where the apparently unranked (but see rank indicated on p. 279) groups are a medley of taxa, now attributed to *Bothriochloa*, *Chrysopogon* Trin. (*Vetiveria* Bory), *Sorghastrum* Nash, and *Sorghum* Moench. A recent paper by Soreng & Pennington (2003) also did not resolve the question of the type species.

Key to the species-

1. Panicle, lowest raceme shorter than main axis of inflorescence
..... 1. *B. bladhii*
1. Subdigitate, lowest raceme longer than main axis of inflorescence 2
2. Upper glumes hairy on the upper part of nerves. Lower glume of sessile spikelet without a circular pit 2. *B. ischaemum*
2. Upper glumes glabrous. Lower glume of sessile spikelet with a distinct circular pit 3. *B. pertusa*

1. *Bothriochloa bladhii* (Retz.) S. T. Blake

Proc. Roy. Soc. Queensland 80: 62. 1969. - *Andropogon bladhii* Retz., Observ. Bot. 2: 27. 1781. - *Andropogon annulatus* Forssk. var. *bladhii* (Retz.) Hack. in A. DC., Monogr. Phan. 6: 572. 1889. - *Dichanthium bladhii* (Retz.) Clayton, Kew Bull. 32: 3. 1978. - **Typus**: China, *Bladh s.n.* in *Herb. Retzius* (LD, holo, 94/019-0745, SI, photo). **Fig. 1.**

-*Andropogon intermedius* R. Br., Prodr. 1: 202. 1810. -*Andropogon intermedius* R. Br. var. *genuinus* Hack. in A. DC., Monogr. Phan. 6: 485. 1889. *nom. inval.* -*Sorghum intermedium* (R. Br.) Kuntze, Rev. Gen. Pl. 2: 792. 1891. -*Amphilophis intermedia* (R. Br.) Stapf, Agric. News (Barbados) 15: 179. 1916; in Prain, Fl. Trop. Afr. 9: 174. 1917. -*Bothriochloa intermedia* (R. Br.) A. Camus, Ann. Soc. Linn. Lyon II, 76: 164. 1931. -*Dichanthium ischaemum* (L.) Roberty subvar. *intermedium* (R. Br.) Roberty, Boissiera 9: 160. 1960. *nom. inval.* -*Dichanthium compilospecies intermedium* (R. Br.) De Wet & J.R. Harlan, Amer. J. Bot. 53: 97. 1966. -Type: Australia, *R. Brown* 6184 (BM, holo, photo in BRI, K!).

-*Andropogon glaber* Roxb. [Hort. Bengal.: 7. 1814. *nom. nud.*] Fl. Ind. 1: 271. 1820. -*Andropogon intermedius* R. Br. subvar. *glaber* (Roxb.) Hack. in A. DC., Monogr. Phan. 6: 487. 1889. -*Amphilophis glabra* (Roxb.) Stapf in Prain, Fl. Trop. Afr. 9: 172. 1917. -*Bothriochloa glabra* (Roxb.) A. Camus, Ann. Soc. Linn. Lyon II, 76: 164. 1931. -*Dichanthium ischaemum* (L.) Roberty subvar. *glabrum* (Roxb.) Roberty, Boissiera 9: 159. 1960. *nom. inval.* -*Bothriochloa bladhii* (Retz.) S.T. Blake subsp. *glabra* (Roxb.) B.K. Simon, Austrobaileya 3: 79. 1989. -Type: India, Bengal, *Roxburgh*, s.n. (BM, holo; BR, G; *Icon. ined.* 1194; CAL, K).

-*Andropogon punctatus* Roxb., Hort. Beng.: 82. 1814. *nom. nud.*, Fl. Ind. 1: 268. 1820. -*Andropogon perfoissus* Nees & Meyen ex Steud., Nomencl., ed. 2, 1: 92. 1840. *nom. nud.* -*Andropogon intermedius* R. Br. var. *punctatus* (Roxb.) Hack. & subvar. *perfoissus* Hack. in A. DC., Monogr. Phan. 6: 487. 1889. -*Bothriochloa intermedia* (R. Br.) A. Camus var. *punctata* (Roxb.) Keng, Clav. Gen. Sp. Gram Prim. Sin.: 244. 1957. *nom. inval.* -*Dichanthium*

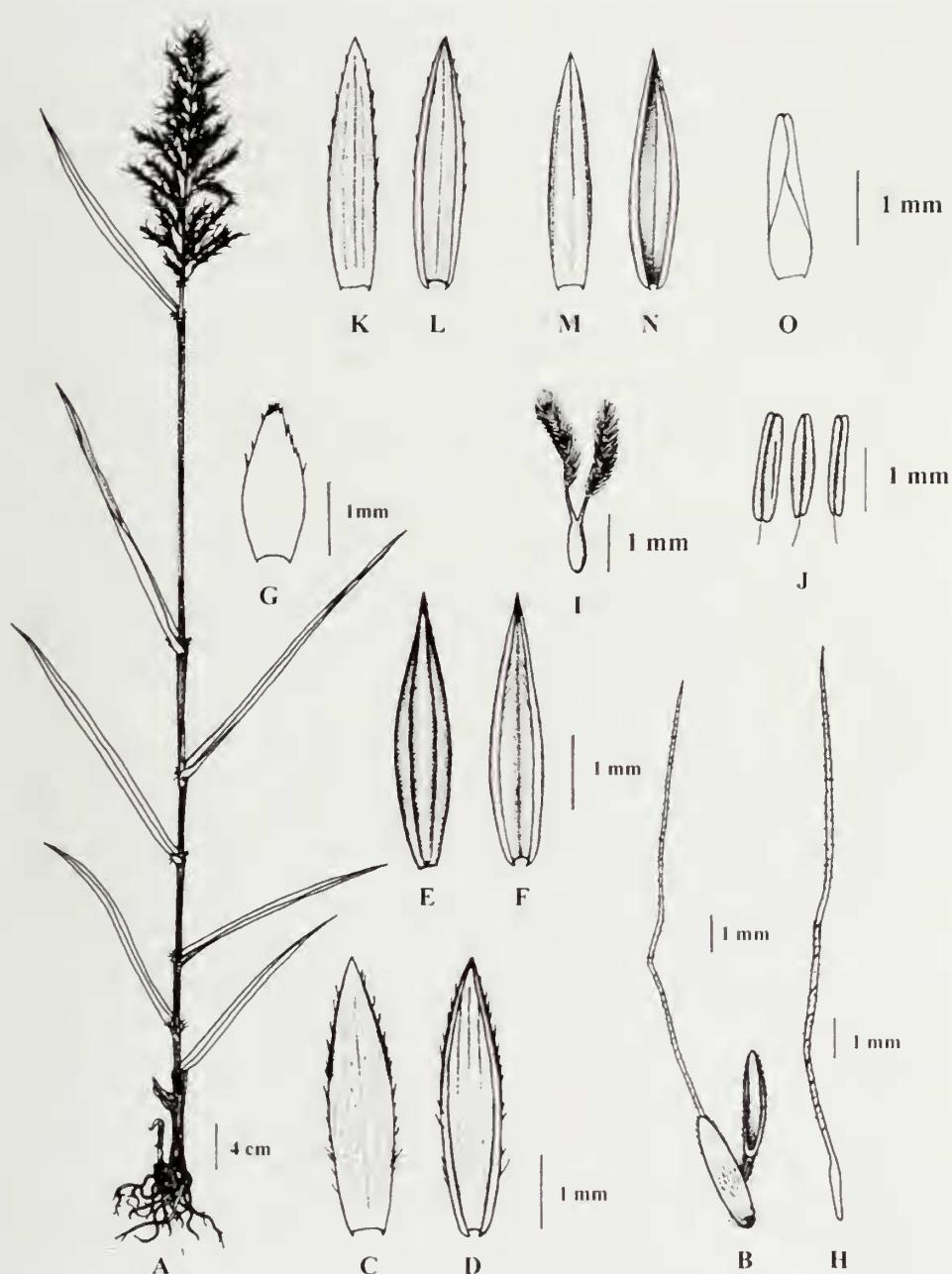


Figure 1. *Bothriochloa bladhii*. A. Habit; B. Spikelet pair; C-J. Sessile spikelet: C-D. Lower glumes; E-F. Upper glumes; G. Lower lemma; H. Upper lemma; I. Pistil; J. Stamens; K-O. Pedicelled spikelet: K-L. Lower glume; M-N. Upper glumes; O. Lower lemma. [Drawing was based on *O. Neamsuvan 166 (BCU)*].

ischaemum (L.) Roberty subvar. *punctatum* (Roxb.) Roberty, Boissiera 9: 160. 1960. *nom. inval.* - *Bothriochloa bladhii* (Retz.) S.T. Blake var. *punctata* (Roxb.) R.R. Stewart, Kew Bull. 29: 444. 1974. - Lectotype: India, "mountain grass" Roxburgh s.n. (G, holo), designated by Roberty [Boissiera 9 (1960) 160]; *Herb. Hornemann s.n.*: C; *Roxburgh s.n. ex Herb. Hornemann in Herb. Trinius* 283.1: LE, fragments only, IDC microfiche BT-16/1]; *Icon. ined.* 892 (CAL, K).

- *Andropogon haenkei* J. Presl in C. Presl, Reliq. Haenk. 1: 340. 1830.

- *Andropogon intermedius* R. Br. var. *haenkei* (J. Presl) Hack. in A. DC., Monogr. Phan. 6: 486. 1889. - *Bothriochloa glabra* (Roxb.) Stapf subsp. *haenkei* (J. Presl) Henrard, Blumea 3: 456. 1940. - *Dichanthium ischaemum* (L.) Roberty subvar. *haenkei* (J. Presl) Roberty, Boissiera 9: 159. 1960. *nom. inval.* - Lectotype: Philippines, Luzon, *Haenke s.n.* (PR, holo), here designated.

- *Andropogon caucasicus* Trin., Mém. Acad. Imp. Sci. St. Pétersbourg, VI, Sci. Math. 2: 286. 1832. - *Sorghum caucasicum* (Trin.) Griseb. in Ledeb., Fl. Ross. 4: 476. 1853. - *Andropogon intermedius* R. Br. var. *caucasicus* (Trin.) Hack. in A. DC., Monogr. Phan. 6: 486. 1889. - *Bothriochloa caucasica* (Trin.) C.E. Hubb., Bull. Misc. Inform. Kew 1939: 101. 1939. - *Dichanthium caucasicum* (Trin.) S.K. Jain & Deshp., Bull. Bot. Surv. India 20: 133. 1979 ("1978"). - Type: *E. Caucasus, Wilhelms s.n. A° 1827 in Herb. Trinius* 178.1 (LE, IDC microfiche BT-16/1).

- *Rhaphis stricta* Nees in Hooker's J. Bot. Kew Gard. Misc. 2: 99. 1850.

- *Andropogon leptanthus* Steud., Syn. Pl. Glumac. 1: 391. 1854, non *Andropogon strictus* Host., 1802. - *Chrysopogon strictus* Nees ex B.D. Jacks., Index Kew. 1: 95. 1893; 2: 704. 1895; *nom. inval.*, in *syn.* - Type: *Cuming* 1400 (CGE, holo; G, GOET, K!, L!, P, W).

- *Andropogon intermedius* R. Br. subvar. *puberulus* Hack. in A. DC., Monogr. Phan. 6: 487. 1889. - Type: *Not indicated*, material in W to be studied.

- *Andropogon pertusus* (L.) Willd. var. *vegetior* Hack. in A. DC., Monogr. Phan. 6: 481. 1889. - Type: Sudan, *Schweinfurth* 1027 (W, holo; K!).

- *Andropogon odoratus* Lisboa, J. Bombay, Nat. Hist. Soc. 4: 123. 1889.

- *Amphilophis odorata* (Lisboa) A. Camus, Rev. Int. Bot. Appl. Agric. Trop. 1: 305. 1921. - *Bothriochloa odorata* (Lisboa) A. Camus, Ann. Soc. Linn. Lyon II, 76: 165. 1931. - Type: India, Bombay, *Lisboa s.n.* (BLATT, holo).

- *Amphilophis glabra* (Roxb.) Stapf var. *panpera* Stapf ex Ridl., Fl. Malay Penins. 5: 209. 1925. - Lectotype: *not resolved*, material in SING to be studied.

Culms erect, stout, up to 2 m high, nodes glabrous or pubescent, internodes terete or grooved on one side. **Leaf** sheaths terete, keeled in the upper part; **ligules** ca 1 mm long; leaf blades up to 43 by 1 cm, lower surface glabrous, upper surface scabrous and covered with long hairs at basal part, base

subcordate, apex long acuminate, margin scaberulous. **Inflorescence** a large panicle, 12-17 by 4-5 cm, axis up to 15 cm long, primary branches whorled, simple or divided, racemes up to 5 cm long, the lowest raceme shorter than the central axis, joints 1.5-2.3 mm long. Sessile **spikelets** elliptic, ca 2.5 mm long, callus 0.2-0.5 mm long; lower **glumes** elliptic to oblong, greenish yellow, 2.5-3 mm long, obscurely 7-9-nerved, occasionally 1-pitted, upper glumes 2.5-3 by 1-1.2 mm, sparsely hairy on upper part of keel, otherwise glabrous; lower **lemmas** lanceolate, 2-2.5 by 0.5-0.7 mm, glabrous, apex obtuse; upper **lemmas** ca 1.5 mm long, awn ca 1.5 mm long; lodicules c. 0.2 mm long; anthers ca 1.5 mm long; pedicelled spikelets 2.5-3 mm long, callus short; lower glumes lanceolate, ca 3 by 1 mm, 6-nerved, greenish yellow, pectinately setose on keels, apex acute; upper glumes lanceolate, 2-2.8 by 0.5-0.8 mm, 3-nerved; lower lemmas lanceolate, ca 2 by 0.5 mm, apex acute; anther ca 1 mm long, sometimes barren.

Specimens examined: S. Lægaard & M. Norsangsri 21875 (AAU); K. Larsen, S.S. Larsen, C. Niyomdharn, W. Ueachirakan & P. Sirirugsa 42528 (AAU); K. Larsen, S.S. Larsen, A.S. Barfod, W. Nanakorn, W. Ueachirakan & P. Sirirugsa 41757 (AAU); S. Lægaard & M. Norsangsri 21693 (AAU); S. Lægaard 21758 (AAU); J.F. Maxwell 74-597 (AAU, BK); J.F. Maxwell 85-928 (AAU, PSU); O. Neamsuvan 166 (BCU); J. Sadakorn 208 (BK); T. Smitinand 3416 (BKF); M. Lazarides 7445 (BKF, K, L); A. Marcan 1815 (BM); A.F.G. Kerr 6955, 7987, 9354, 11334, 13558 (BM, K); Th. Sorensen, K. Larsen & B. Hansen 5481, 5891 (C, K); J.F. Maxwell 92-567 (CMU, P); Ch. Charoenphol, K. Larsen & E. Warncke 4878 (K); T. Smitinand 2035, 6087 (K); A. Marcan 1589 (K); A.F.G. Kerr 9331, 19781 (K); Put 2049 (BM, K); A.F.G. Kerr 3842 (C, K); K. Larsen 9993 (C, K); G. Murata, N. Fukuoka & C. Phengklai T. 16986 (P).

Ecology: Along roadside, open area, abandon field. Alt. 0-1500 m.

Uses: As a forage grass.

Vernacular name: Ya khaem khok, Ya khi ma

Trade names: Australian bluestem, Forest bluegrass, Long-leaved beard grass.

Distribution: THAILAND. Northern: Chiang Mai, Sukhothai; North-Eastern: Loei; Central: Bangkok, Saraburi, Lop Buri, Nakhon Nayok; Eastern: Nakhon Ratchasima; South-Eastern: Chon Buri, Chantaburi, Sa Kaeo; Southern: Chumphon, Songkhla, Krabi, Yala. Also tropical Africa and Asia, introduced elsewhere.

2. *Bothriochloa ischaemum* (L.) Keng

Contr. Biol. Lab. Chin. Assoc. Advancem. Sci., Bot. 10: 201. 1936; Henrard, Blumea 3: 457. 1940. isonym; Mansf. ex Cuénod., Fl. Tunisie: 56. 1954. isonym.

-*Andropogon ischaemum* L., Sp. Pl.: 1047. 1753. -*Andropogon ischaemum* var. *genuinum* Hack. in A. DC., Monogr. Phan. 6 (Apr 1889) 475, nom. inval.

-*Andropogon digitatus* St.-Lag. in Cariot, Étude Fl., ed. 8, 2: 898. 1early 1889. nom. superfl. -*Sorghum ischaemum* (L.) Kuntze, Revis. Gen. Pl. 2: 792. 1891. -*Amphilophis ischaemum* (L.) Nash, N Amer. Fl. 17, 2: 124. 1912.

-*Dichanthium ischaemum* (L.) Roberty, Boissiera 9: 160. 1960. -**Lectotype**:

S. Europe, Herb. Linn. 1211.26 (LINN, holo), designated by Marchi & Longhi-Wagner [Bol. Inst. Bioci. Univ. Fed. Rio Grande do Sul 57: 41. 1998]

= *Andropogon gerardii* Vitm.; a better choice for stability is *Herb. Burser I*, 101 (UPS, holo, microfiche IDC 1064), designated by Scholz [in Cafferty, et al., Taxon 49: 245. 2000]. **Fig. 2.**

-*Andropogon angustifolius* Sibth. & Sm., Prodr. Fl. Graec. 1: 47. 1806. -Type: Greece, *Sibthorp s.n.* (OXF, holo).

-*Andropogon radicans* Lehm., Sem. Hort. Bot. Hamburg.: 16. 1827.

-*Andropogon ischaemum* L. var. *radicans* (Lehm.) Hack. in A. DC., Monogr. Phan. 6: 476. 1889. -Type: Cultivated, extant?

-*Andropogon ischaemum* L. var. *songaricus* Rupr. ex Fisch. & Meyen, Enum. Pl. Nov.: 2. 1841. -*Bothriochloa ischaemum* (L.) Keng var. *songarica* (Fisch. & Meyen) Celarier & J.R. Harlan, J. Linn. Soc. Bot. 55: 758. 1958. -*Andropogon ischaemum* L. forma *songaricus* (Fisch. & Meyen) Kitag., Jap. J. Bot. 36: 20. 1961. -Type: Songaria, Schrenk s.n. (LE, holo; K).

-*Andropogon ischaemum* L. var. *fallax* Hack. in A. DC., Monogr. Phan. 6: 476. 1889. -Type: Timor (W, holo; "A. annulatus" Kunth Herb. ex p.).

-*Andropogon taiwanensis* Ohwi, J. Jap. Bot. 12: 652. 1936. -Type: Taiwan, Shimada 4766 (KYO, holo).

Culms 20-60 cm high, nodes usually bearded. **Leaf** sheaths 4-6 cm long; **ligules** ca 1 mm long; leaf-blades 3-10 cm by 2-4 mm, hairy on both surfaces, margin scaberulous. **Inflorescence** subdigitate of 3-8 racemes, axis 0.5-1.5 cm long, the lowest raceme longer than the axis, racemes 4-6 cm long, joints 2-2.5 mm long. Sessile **spikelets** lanceolate, ca 4 mm long, callus hairy, ca 0.5 mm long; lower **glumes** lanceolate, 3.8-4 by 0.7-1 mm, 7-nerved, green; upper glumes oblong, 3.5-4 by 1 mm, hairy on the upper part of nerves; lower **lemmas** lanceolate, ca 3 by 0.5 mm, glabrous, apex acute; upper lemmas ca 2 mm long, awn brown, ca 1.3 cm long, short hairy; lodicules ca 0.3 mm long; anthers 1-1.5 mm long; pedicelled spikelets ca 3 mm long; pedicel ca 3 mm long, hairy on both margins; lower glumes oblong, 3 by 0.8-1 mm, 9-nerved, hairy on upper half part of keel, apex acute; upper glumes oblong, ca 3 by 1 mm, 3-5-nerved, margin ciliolate; lower lemmas obovate, 2-2.5 by 1-1.5 mm,

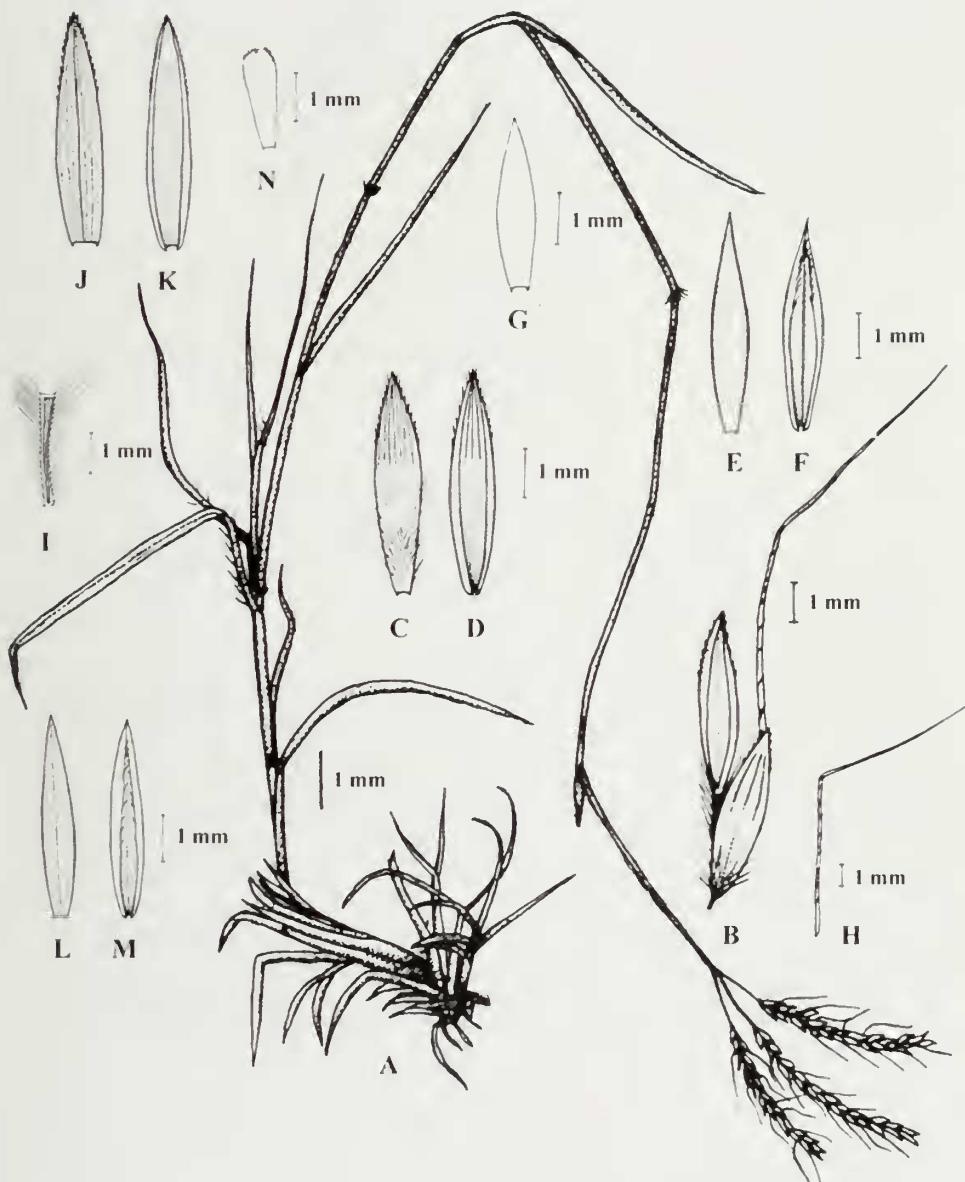


Figure 2. *Bothriochloa ischaemum*. A. Habit; B. Spikelet pair; C-H. Sessile spikelet: C-D. Lower glumes; E-F. Upper glumes; G. Lower lemma; H. Upper lemma; I-N. Pedicelled spikelet: I. Pedicel; J-K. Lower glumes; L-M. Upper glumes; N. Lower lemma. [Drawing was based on Y. Sirichanorn 24 (BCU)].

apex obtuse to truncate; anthers 0.8-1 mm long, or barren.

Specimens examined: P. Sirirugsa 71 (BCU); Y. Sirichamorn 24 (BCU); A.F.G. Kerr 19651, 19701 (K).

Ecology: Open or shady deciduous forest. Alt. 0-300 m.

Uses: Used for erosion control and forage.

Trade names: Old World bluestem, Plains bluestem, Yellow bluestem.

Distribution: THAILAND. Eastern: Buri Ram; Central: Bangkok, Suphan Buri; South-western: Kanchanaburi. Also from S Europe to China, introduced elsewhere.

Notes: This has been introduced in Thailand, but apparently it does not persist. A form with pubescent nodes has been distinguished as var. *songarica* (Rupr. ex Fisch. & C.A. Mey.) Celarier & J.R. Harlan. This seems hardly worth of any recognition.

3. *Bothriochloa pertusa* (L.) A. Camus

Ann. Soc. Linn. Lyon II, 76: 164. 1931; Maire, Bull. Soc. Hist. Nat. Afrique N. 31: 45. 1940. isonym. - *Holcus pertusus* L., Mant. Pl. 2: 301-302. 1771. - *Andropogon pertusus* (L.) Willd, Sp. Pl. 4(2): 922. 1806. - *Lepeocercis pertusa* (L.) Hassk., Pl. Jav. Rar.: 52. 1848. - *Elionurus pertusus* (L.) Nees ex Steud., Syn. Pl. Glumac. 1: 364. 1854. - *Andropogon pertusus* (L.) Willd. var. *genuinus* Hack. in A. DC., Monogr. Phan. 6: 480. 1889. *nom. inval.* - *Amphilophis pertusa* (L.) Nash ex Stapf, Agric. News (Barbados) 15: 179. 1916; Fl. Trop. Afr. 9: 175. 1917. - *Dichanthium ischaemum* (L.) Roberty subvar. *pertusum* (L.) Roberty. Boissiera 9: 160. 1960. *nom. inval.* - *Dichanthium pertusum* (L.) Clayton, Kew Bull. 32: 4. 1977. - **Lectotype:** "India orientalis". *Herb. Linn.* 1212.16 (LINN, holo, designated by Clayton, 1977). **Fig. 3.**

- *Andropogon panormitanus* Parl., Diar. 9 Congress. Scienz. Ital. Venezia. sine pag. 1847; Fl. Ital. 1: 140. 1848. - *Andropogon pertusus* (L.) Willd. var. *panormitanus* (Parl.) Hack. in A. DC., Monogr. Phan. 6: 481. 1889. - *Bothriochloa panormitana* (Parl.) Pilger in Engler & Prantl, Nat. Pfanzenfam., ed. 2, 14e: 161. 1940; Brullo, Giorn. Bot. Ital. 129: 173. 1995. isonym. - Lectotype: Sicily, not resolved.

- *Andropogon angustifolius* auct. non Sibth. & Sm.: Parl., Fl. Palermo 1: 269. 1845.

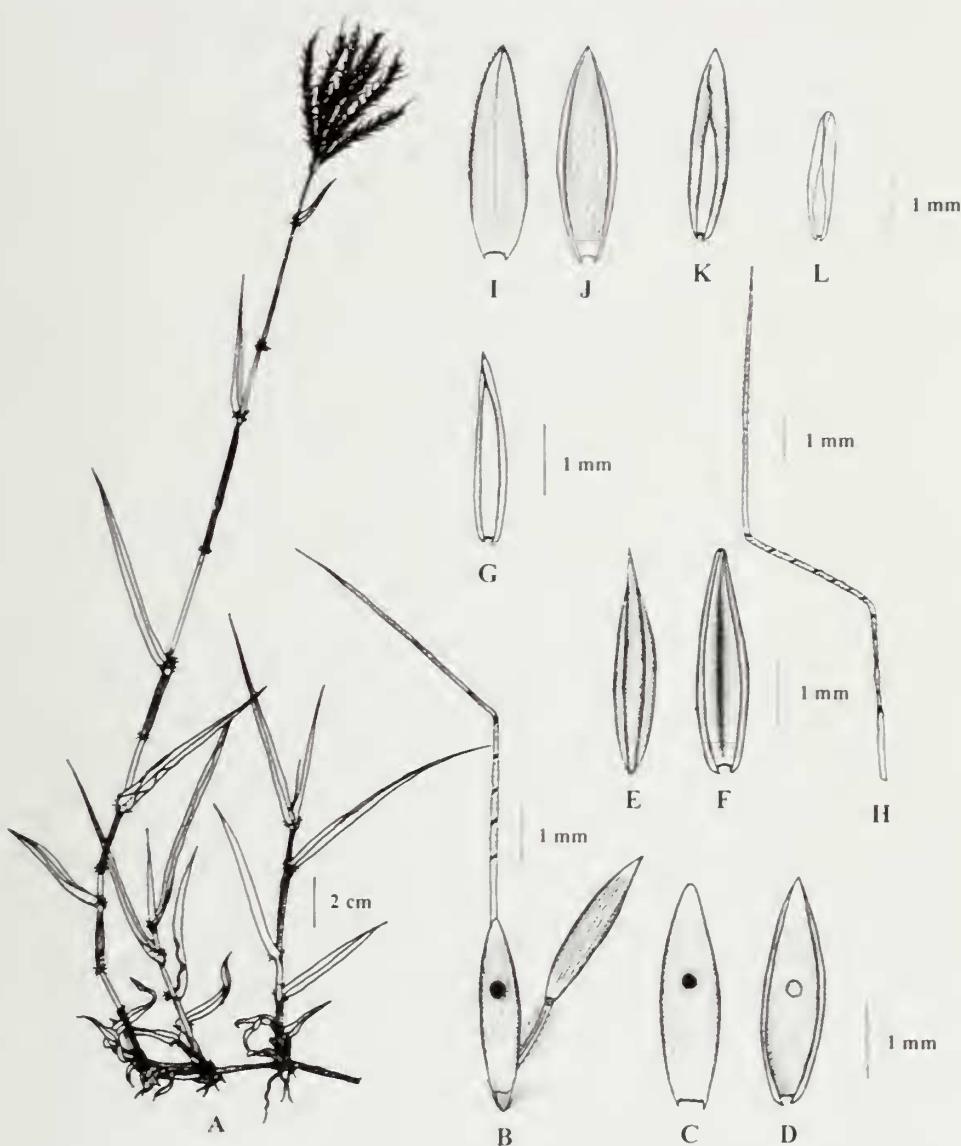


Figure 3. *Bothriochloa pertusa*. A. Habit; B. Spikelet pair; C-H. Sessile spikelet; C-D. Lower glumes; E-F. Upper glumes; G. Lower lemma; H. Upper lemma; I-L. Pedicelled spikelet; I-J. Lower glumes; K. upper glume; L. lower lemma. [Drawing was based on *O. Neamsuvan* 167 (BCU)].

Culms up to 80 cm high, grooved on one side, nodes bearded. **Leaf** sheaths 3-5 cm long; **ligules** 0.5 mm long, tufted hairs on both sides of ligules 3 mm long; leaf blades linear, 3-20 cm by 3 mm, sparsely short hairy on both surfaces, base subcordate to rounded, apex acuminate, margin scaberulous. **Inflorescence** digitate of 3-10 racemes, axis 1-3.5 cm long, racemes 4-5 cm long, the lowest raceme longer than the central axis; joints *ca* 3 mm long. Sessile **spikelets** elliptic to oblong, *ca* 3 mm long, callus 0.4-0.5 mm long; lower **glumes** oblong, 2.5-2.8 by 1 mm, 9-11-nerved, shiny, 1-pitted; upper glumes oblong, 3-3.5 by 1 mm, glabrous; lower **lemmas** broadly ovate, 1.5-2.5 by 0.8 mm, 1-nerved, apex obtuse to truncate, margin ciliate at the upper part; upper lemmas *ca* 2 mm long, 1-nerved; awn 1.5-2 cm long, short hairy; **lodicules** *ca* 0.2 mm long; anthers 1-1.5 mm long; pedicelled spikelets *ca* 3 mm long; callus *ca* 0.5 mm long, hairy; pedicel *ca* 3 mm long, covered by up to 3.5 mm long hairs on both margins; lower glumes oblong, 3.5 by 1.0-1.2 mm, 10-nerved, dorsally with a purple stripe near apex, 0-3-pitted, apex obtuse; upper glumes elliptic, *ca* 2.5 by 1 mm, 3-nerved; lower lemmas obovate, *ca* 2 by 1 mm, apex acute; anthers 0.8-1 mm long.

Specimens examined: *S. Lægaard* and *M. Norsangsri* 21874, 21885 (AAU); *BRD* 57 (AAU); *K. Larsen*, *S.S. Larsen*, *A.S. Barfod*, *W. Nanakorn*, *W. Ueachirakan* and *P. Sirirungsa* 41014, 41566 (AAU); *J.F. Maxwell* 74-654 (AAU, L); *K. Larsen*, *T. Smitinand* and *E. Warncke* 1112 (AAU, K); *O. Neamsuwan* 167 (BCU); *C. Chermsirivathana* 143, 201 (BK); *Put s.n.* (BK); *Y. Paisooksantivatana* 813-82 (BK); *A.F.G. Kerr* 13432 (BK, BM, K); *M. Lazarides* 7434 (BKF, C, K, L); *K. Larsen* 8304 (C); *Th. Sørensen*, *K. Larsen* and *B. Hansen* 2061 (C); *Th. Sørensen*, *K. Larsen* and *B. Hansen* 2477 (C, L); *Th. Sørensen*, *K. Larsen* and *B. Hansen* 2516 (C, L, P); *Th. Sørensen*, *K. Larsen* and *B. Hansen* 2031 (C, P); *G. Murata*, *K. Iwatsuki* and *C. Phengklai* T-14816 (L, P); *A.F.G. Kerr* 3858 (K); *Dee* 8523 (K); *Somnai* 63 (The Herbarium of Department of Botany, Kasetsart University).

Ecology: Open areas, along road sides. Alt. 0-1,500 m.

Uses: Forage, resistant to trampling, drought, and grazing.

Vernacular name: Ya tot lueat, Ya hom, Ya hang ma

Trade names: Pitted bluestem, Pitted bluegrass, Seymour grass, Sourgrass, Wiregrass.

Distribution: THAILAND. Northern: Nakhon Sawan; North-Eastern: Phetchabun, Loei Khon Kaen; Eastern: Nakhon Ratchasima, Buri Ram;

Central: Bangkok, Lop Buri, Ayutthaya, Samut Prakan, Saraburi; South-Western: Prachuap Khiri Khan, Kanchanaburi; Southern: Chumphon, Songkhla, Trang. S Africa to Thailand, introduced elsewhere.

Note: In Thailand, this species is very similar to *B. ischaemum*, but it differs from *B. ischaemum* by the pit in the lower glume of the sessile spikelet.

Discussion

Because of the genetical complexity, most recent authors, e.g., Chen and Phillips (2006) have regarded *B. bladhii* as a polymorphic species that includes all forms with an elongate inflorescence axis. Yet, they thought that 2 varieties can be distinguished.

- 1a. Lower glume of sessile and pedicelled spikelet without a pit on the back *var. bladhii*
- 1b. Lower glume of sessile and pedicelled spikelet with 1-3 pits on the back *var. punctata*

However, this is not supported by some specimens found in Thailand where pitted and pitless glumes occurred in the same inflorescence. It is congruent with Bhutan specimens (Noltie, 2000). Moreover, the many forms of *B. bladhii* represent a complex species where all grades of intermediate forms appear to be present (Celarier and Harlan, 1955), indicating that this distinction is rather dubious.

For *B. ischaemum*, it is distinguished from *B. pertusa* by its lower glume of the sessile spikelet without a pit. Interestingly, Celarier and Harlan (1955) stated that glumes of the sessile spikelet in *B. ischaemum* may be slender without pits but with a slight tendency toward pitting. It means there is a gradual transition form to *B. pertusa*.

Sathagul (1990) reported *B. insculpta* for Thailand, but her specimen (*Sommai* 63) turned out to belong to *B. pertusa*. From intensively literature review, the morphological characters of these 2 species are very similar, and therefore Celarier and Harlan (1955) regarded them as part of the *B. pertusa* complex.

As mentioned above, it seems that the species boundary within *Bothriochloa* is blurred. Possibly a molecular study of these 3 species groups, *B. bladhii*, *B. ischaemum* and *B. pertusa*, might clarify taxonomic delimitations, but in view of the great number of forms and the widespread distribution of the “species”, it seems unlikely that the seminal experiments of Celarier and Harlan can be feasibly repeated.

Bothriochloa bladhii and *B. pertusa* are common and widely

distributed throughout Thailand. On the contrary, *B. ischaemum* seems to be rare. Only a few specimens were available in the herbaria and only on a few occasions were seen in the field. As in Thailand it is not considered to be a valuable forage grass, there is a risk that it may become extinct.

Acknowledgements

We would like to thank the Center of Excellence in Biodiversity, Faculty of Science, Chulalongkorn University (CEB_D_11_2006), the 90th Anniversary of Chulalongkorn University Fund and the Development and Promotion of Science and Technology Talents Project of Thailand (DPST) for funding of this research. We also thank the directors and curators of AAU, BCU, BK, BKF, BM, C, CMU, K, L, P, PSU and The Herbarium of Department of Botany, Kasetsart University for making the specimens available for this study.

References

Bor, N.L. 1965. Studies in the Flora of Thailand: Gramineae. *Dansk Botanisk Arkiv* **23**: 156.

Bor, N.L. 1968. *Flora of Iraq* vol. 9: Gramineae. The Ministry of Agriculture of the Republic of Iraq, Bagdad.

Celarier, R.P. and J.R. Harlan. 1955. *Studies on Old World Bluestems*. Department of Botany and Plant Pathology and Agronomy, USA.

Chen, S.-L. and S.M. Phillips. 2006. *Flora of China*. vol. 22, pp. 607-609. Science Press, Beijing & MBG Press, St. Louis.

Clayton, W.D., K.T. Harman and H. Williamson. 2008. The online world grasses flora. [Online]: <http://www.kew.org/data/grasses-db/sppindex.htm> [2009, August 12].

De Wet, J.M.J. and J.R. Harlan. 1966. Morphology of the compilospecies *Bothriochloa intermedia*. *American Journal of Botany* **53**: 94-98.

Kuntze, C.E.O. 1891. *Bothriochloa* Kuntze. *Revisio generum plantarum* **2**: 762. Felix, Leipzig, etc.

Nanakorn, W. and M. Norsangsri. 2001. *Species enumeration of Thai Gramineae*, pp. 33-34. Herbarium Queen Sirikit Botanic Garden, Chiang Mai, Thailand.

Nash, G.V. 1901. Gramineae, pp. 71. In: N.L. Britton (ed.), *Manual of the Flora of the Northern States and Canada*. Holt & Co., New York.

Noltie, H.J. 2000. *Flora of Bhutan* vol. 3(2), pp. 796-798. Royal Botanic Garden Edinburgh, Scotland.

Roberty, G. 1960. Monographie systématique des Andropogonées du globe. *Boissiera* 9: 167.

Sathagul, S. 1990. *The taxonomic study of the genus Dichanthium Willemet and its allies in Thailand*. Master's thesis. Department of Botany, Graduate School, Kasetsart University.

Soreng, R.J. and S.J. Pennington. 2003. Catalogue of New World Grasses (Poaceae). 3. Subfamilies Panicoideae, Aristoideae, Arundinoideae, and Danthonioideae. Contribution of US National Herbarium 46: 84.

